Dept. of Homeland Security "Dirty Bomb" Guidance

Allowing High Long-Term Radiation Doses to the Public Without Cleanup

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DHS January 2006 Long-Term Cleanup Guidance

- Relies Upon "Benchmarks" from Advisory Bodies Such as ICRP
- ICRP Generic Reference Levels:
  - No Mandatory Cleanup Until Dose Approaches 10 R/yr
  - Cleanup Generally Not Justifiable When Doses Are Less Than 1 R/yr
  - Between 1 & 10 R/yr, Decision Whether to Clean Up to Be Made on a Case-by-Case Basis

Key Conversion Factor

- Current official government conversion factor (pre-BEIR VII) is 8.46×10^{-4} cancer/person-rem (FGR 13)
- National Research Council updated risk figure (BEIR VII) is 1.14×10^{-3}
- **In round numbers, one cancer per thousand person-rems**

10 Rem/year

- Equivalent ~1700 chest Xrays/year
- 50,000 over 30 years [standard exposure period]
- Equivalent to a chest Xray every 5 hours for 30 years
- Cancer risk of 3.4×10^{-1}
- 1 in 3 people exposed expected to develop cancer from the exposure (BEIR VII)

- Exceeds Standard Acceptable Risk Range of 10^{-6} to 10^{-4} by Factors of 3400-340,000

Other Benchmarks

- When Other "Benchmarks" are Used, and the Early, Intermediate and Late Phase Guidance Levels are Summed, the DHS Guidance Results in Total Excess Risks Ranging from 1 in 3 to 1 in 60.
- These risks are orders of magnitude greater than generally accepted for exposure to carcinogens (10^{-4} to 10^{-6})

Risk Estimates May Be Low

- A series of studies have suggested that the BEIR VII/Official Government Radiation Risk Conversion May Understate True Risks
- IARC 15-nation study, SSFL, Oak Ridge, Canadian radiation worker studies
- DDREF questionable; shouldn't be used anyway with doses this large

Conclusion

- DHS guidance would permit very high radiation exposures to the public without actions to clean up the contamination
- Risks orders of magnitude higher than generally accepted for exposure to carcinogens
- Policy would compound the harm done by a dirty bomb and multiply the terrorists' power

CANCER RISKS ASSOCIATED WITH
DEPARTMENT OF HOMELAND SECURITY DIRTY BOMB CLEANUP GUIDANCE*

Table 1 Long-Term Cleanup Phase

Proposed Cleanup Benchmark[1]	= # of Chest X-rays Per Year[2] [Over 30 Years]	Risk of Cancer[3]	=1 Cancer Per X People Exposed	Factor by Which EPA Acceptable Risk Range[4] Is Exceeded
100 mrem/year[5]	17 [500]	3.4×10^{-3}	300	34-3,400
500 mrem/year[6]	83 [2,500]	1.7×10^{-2}	60	170-17,000
1,000 mrem/year[7]	170 [5,000]	3.4×10^{-2}	30	340-34,000
2,000 mrem/year[8]	340 [10,000]	7×10^{-2}	15	700-70,000
10,000 mrem/year[9]	1,700 [50,000]	3.4×10^{-1}	3	3,400-340,000

Table 2 Early Phase

Proposed Protective Action Level	= # of Chest X-rays Per Year	Risk of Cancer	=1 Cancer Per X People Exposed	Factor by Which EPA Acceptable Risk Range Is Exceeded
1,000 mrem[10]	170	1.14×10^{-3}	880	11-1100
5,000 mrem/year[11]	830	5.7×10^{-3}	175	57-57,000

* Based on the most recent risk estimates for exposure to ionizing radiation from the National Academy of Sciences/National Research Council in *Health Risks from Exposure to Low Levels of Ionizing Radiation*, "BEIR VII" (2006). The NAS BEIR reports are relied upon by all U.S. agencies for establishing radiation risks. BEIR VII was prepared at the request of and with the funding of the Departments of Defense, Energy, and Homeland Security, and the Environmental Protection Agency.

Table 3 Intermediate Phase

Proposed Levels 1st Year	Proposed Levels subsequent years[12]	# of Chest X-rays Per Year *[Over 3 Years[13]]*	Risk of Cancer[14]	=1 Cancer Per X People Exposed	Factor by Which EPA Acceptable Risk Range Is Exceeded[15]
2,000 mrem 1st year		333	2.3×10^{-3}	430	23-2,300
	500 mrem/year– general exposure	83 *[250]*	1.7×10^{-3}	580	17-1,700
	+500 mrem/year – food interdiction	83 *[250]*	1.7×10^{-3}	580	17-1,700
	500 mrem/year drinking water interdiction	83 *[250]*	1.7×10^{-3}	580	17-1,700
	Total 1,500 mrem/yr	250 *[750]*	5.1×10^{-3}	190	51-5,100

Table 4 Total Dose to Public from DHS Proposed Radiation Guidelines

Phase	Proposed Dose Level	= # of Chest X-rays	Risk of Cancer	=1 Cancer Per X People Exposed	# of cancers produced if the exposed population is 10,000 people[16]	Factor by Which EPA Acceptable Risk Range Is Exceeded
Early	5,000 mrem	833	5.7×10^{-3}	175	57	
Intermediate – 1st yr	2,000 mrem 1st year	333	2.3×10^{-3}	440	23	
Yrs 2-4 (total)	4,500 mrem	750	5.1×10^{-3}	190	51	
Late Phase[17]	3,000- 300,000 mrem[18]	500- 50,000	3.4×10^{-3} – 3.4×10^{-1}	290- 3	25- 2,500	
Total[19]	**14,500 – 311,500 mrem**	**2,400 – 52,000**	**1.7×10^{-2} – 3.5×10^{-1}**	**60- 3**	**170 – 3,500**	**170-17,000 - 3,500-350,000**

Endnotes

[1] The Department of Homeland Security cleanup guidance has no specific cleanup standards for the late phase cleanup, implicitly turning away from existing cleanup standards such as EPA's CERCLA requirements, and instead referring to "benchmark" values proposed by nuclear advisory groups, and federal and state government agencies. Particularly referenced is the International Commission on Radiological Protection (ICRP) guidance. These tables examine the risks associated with the extant benchmark recommendations from ICRP and the Health Physics Society (PS), as well as the DOE and NRC proposals made in an earlier draft of the DHS guidance, recognizing that there are far more protective standards in existence, such as EPA's historical cleanup standards, that could be – and should have been – adopted in the DHS guidance as the preferred benchmark.

[2] Standard chest X-ray ≈ 6 mrem. (General Accountability Office Report GAO/RCED-00-152, "Radiation Standards," fn. 3, page 7.) Doses vary by machine.

[3] The pre-BEIR VII official government figure for cancer incidence risk is 8.46×10^{-4}/person-rem, as set forth in Federal Guidance Report 13 (FGR 13). (Put more simply, 8-9 people are expected to come down with cancer from their radiation exposure if 10,000 people each receive 1 rem, or if 1000 people each receive 10 rem). Federal Guidance Report No. 13, *Cancer Risk Coefficients for Environmental Exposure to Radionuclides,* EPA 402-R-99-001, US EPA Office of Radiation and Indoor Air, funded by EPA, NRC, and DOE, September 1999, pp. 179, 182; http://www.epa.gov/radiation/docs/federal/402-r-99-00.pdf. FGR 13 provides estimates of fatal cancer risk of 5.75×10^{-4} per person-rem and total cancer incidence or morbidity (fatal and nonfatal combined) of 8.46×10^{-4} per rem.

Awaiting the newest National Academy of Sciences Report on Biological Effects of Ionizing Radiation (BEIR VII), all federal agencies have used approximately the same mortality risk factors, i.e. the Federal Guidance Report 13 figures cited above. See, e.g., *NRC Policy Statement on Below Regulatory Concern*, 3 July 1990, p. 8, and *NRC 10 CFR Part 20, et al. Radiological Criteria for License Termination; Final Rule*, July 21, 1997, Vol. 62 Federal Register 39058, 39061, noting its reliance on and the similarity of the Federal Guidance 13 and ICRP Publication 60 risk figures; and DOE *Environmental Assessment for the Energy Technology and Engineering Center,* DOE/EA-1345, p. C-3, March 2003. The minor differences between agencies – DOE and NRC at times use mortality figures of 5×10^{-4} / person-rem instead of the Federal Guidance Report 13 figure of 5.75×10^{-4}, particularly in pre-FGR 13 documents -- are inconsequential for the discussion here because of the high magnitude of the risk of the dose limits represented.

The old agency risk estimates from radiation described above were in turn derived in large part from *Health Effects of Exposure to Low Levels of Ionizing Radiation,* the report by the National Academy of Sciences' Committee on the Biological Effects

of Ionizing Radiation (BEIR V), 1990, which sets the risk of fatal cancer at 8×10^{-4} per person-rem. (See NAS BEIR V Report p. 6 and 172-3,5). EPA and other agencies rely upon the NAS numbers, but reduce the risk factor by a Dose and Dose Rate Effectiveness Factor (DDREF). No agency – nor the NAS – accepts the controversial argument put forward by some in the nuclear industry that there is a threshold below which radiation is completely safe, or may even be beneficial ("hormesis"), but all agencies pre-BEIR VII depart from the linear model at low doses by reducing risks at low doses and dose rates by a DDREF of 2 for most cancers, beyond the reduction from just linear scaling from higher doses. BEIR VII recommends a DDREF of 1.5.

When conducting site-specific risk assessments at Superfund sites, EPA uses isotopic-specific risk coefficients rather than rely on the more generic rem-to-cancer risk estimates cited here. However, this type of more accurate risk assessment is not possible prior to a radiological attack.

The assumed exposure period is 30 years, the presumption generally used by EPA's Superfund program for estimating exposure at Superfund sites (although EPA has in other instances assumed a full lifetime of exposure of 70 years.) For simplicity, we have used the official government risk figures for cancer induction from radiation exposure and the less conservative 30-year rather than lifetime exposure assumption. True risks therefore may be higher than presented here, as people may live or work at the same location longer than 30 years, and several studies (e.g., of DOE radiation workers at Oak Ridge, Hanford, and Santa Susana) suggest ten-fold higher cancer risks than assumed in Federal Guidance 13.

If the half-life of the radioniuclide(s) involved were short, there may be a reduction of dose over the 30 year exposure period and therefore a reduction in risk from the figures cited above. If, however, the half-life of the radionuclide(s) were long, there may be no significant dose reduction in that period. Additionally, effects of weathering would need to be taken into account, but that would involve site-specific considerations.

The recent National Academy of SciencesNational Research Council updated BEIR Report (BEIR VII) increases the risk estimates for cancer incidence by approximately a third over the FGR 13 figures cited above. The new risk figure, based on review of the latest research, is approximately 1.14×10^{-3} cancers per person-rem of exposure to a population of standard age and gender distribution. (See e.g., Table 12-9, summing for leukemia and all solid cancers and averaging across gender.) This table is based on the latest National Academy of Sciences risk estimates.

[4] EPA has long set the acceptable risk range for cancer induction from exposure to contaminants (chemicals and radionuclides combined) as $10^{-4} – 10^{-6}$, or one cancer per 10,000 to 1,000,000 people exposed, with the starting point for acceptable risk being one in a million, falling back to no more than one in ten thousand if there are good reasons why the one in a million level cannot be obtained.

See, e.g., CERCLA statute and EPA's implementing guidance. As EPA acknowledged in an earlier draft of the DHS guidance, there may be extraordinary circumstances regarding a dirty bomb requiring, in a particular case, going outside the normal risk range, but the basic cleanup standards should be based on the existing EPA CERCLA risk range.

[5] HPS suggested lower range [*Guidance for Protective Actions Following a Radiological Terrorist Event - Position Statement of the Health Physics Society*, January 2004. Ramona Trovato, in the EPA statement quoted in our letter, says NRC estimates the cancer risk of a 100 mrem/year cleanup standard as 1 in 200 (5×10^{-3}). We give it here as 3.4×10^{-3}. NRC presumably used a longer exposure time (e.g., lifetime) than the 30 years we assumed. Our risk figures here thus might be low (i.e., underestimate true risk) on that basis alone.

[6] HPS suggested upper range; DOE & NRC suggested benchmark [*Risk Management Framework for Radiological Dispersal Device (RDD)/ Improvised Nuclear Device (IND) Incidents (Guidance for Development of Countermeasures),* Rough Draft July 18, 2003, pp. 25, made by public by the trade publication *Inside EPA*

[7] ICRP suggested lower range [ICRP 96, *Protecting People Against Radiation Exposure in the Aftermath of a Radiological Attack,* October 2004, pp. 69-70]

[8] DOE suggested upper range for long-term cleanup standard, DHS Rough Draft July 18, 2003, p. 28. The 2,000 mrem/year proposed limit includes background, which averages in the U.S. ~330 mrem/year, most of it from indoor radon. The 2,000 mrem/year limit with background thus would average ~1,670 mrem/year above background. The contradiction between this value and the 500 mrem/year above background recommendation in the same paragraph is not explained in the DOE appendix to the DHS draft. The X-ray equivalence and risk figures in the succeeding columns for that row are based on the 2,000 mrem/yr figure (i.e., including background). Since all other of the proposed cleanup levels do not include background, to make them comparable, one would reduce the X-ray and risk figures for this one proposed standard by 330/2,000 = 16.5% to get the contribution from the radiation from the dirty bomb alone.

[9] ICRP suggested upper range [ICRP 96, pp. 69-70]

[10] Lower range of recommended protective actions of sheltering and/or evacuation of public

[11] Upper range of recommended protective actions of sheltering and/or evacuation of public

[12] These permitted doses are additive – i.e., one is permitted 500 mrem/year from general contamination such as soil contamination, 500 mrem/year from contaminated food, and 500 mrem/year from contaminated drinking water, for a total of 1,500 mrem/year each year of the intermediate phase after the first year.

[13] These limits are for subsequent years prior to the late phase cleanup. We here assume this takes three years, but it could be longer and the doses thus higher.

[14] For 1st year, risk for dose in that year. For subsequent years, risk for the 3 years following.

[15] The World Trade Center benchmark of aggressive cleanup of chemical toxic materials in apartments–comparable to the intermediate phase here – was accomplished with a 1×10^{-4} lifetime cancer risk cleanup benchmark assuming one year of exposure. These proposed radiation cleanup standards for the intermediate phase would be many times more lax than EPA permitted for the World Trade Center cleanup—a total risk of 7.4×10^{-3}, or 74 times the risk standard used by EPA for the World Trade Center cleanup. See *World Trade Center Indoor Air Assessment: Selecting Contaminants of Potential Concern and Setting Health-Based Benchmarks*, Prepared by the Contaminants of Potential Concern (COPC) Committee of the World Trade Center Indoor Air Taskforce Working Group, Peer Review Draft, September, 2002, pp. 11-12. The overall 30-year long-term cleanup benchmark used by EPA for cleanup of the surrounding area after the World Trade Center attack was also 1×10^{-4}. See *World Trade Center Indoor Environment Assessment: Selecting Contaminants of Potential Concern and Setting Health-Based Benchmarks* May 2003 Prepared by the Contaminants of Potential Concern (COPC) Committee of the World Trade Center Indoor Air Task Force Working Group, p. 58.

[16] Assume, for example, a dirty bomb going off in a crowded downtown metropolitan area where 10,000 people live and/or work in the affected zone. The number could be significantly larger under some radiological weapon scenarios in highly populated areas.

[17] Uses EPA common assumption of 30-year total exposure after cleanup is completed.

[18] Lower figure is based on 100 mrem/year benchmark, upper figure based on 10,000 mrem/year benchmark

[19] Similarly, the range for total exposure--taking into account immediate, intermediate, and late phase cleanup--is bracketed by the totals including the lower long-term cleanup benchmark on the one hand and the upper long-term cleanup benchmark on the other.